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ARMY WIRE ROPE INSPECTION PROGRAM

October 1983

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United States Army
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report covers an investigation into the Army's wire rope inspection procedures and needs. Major Army users of wire rope were located and surveyed for information on their wire rope inspection procedures. The Navy has conducted an investigation into wire rope inspection equipment. They have concluded that a large a.c./d.c. unit should be used for intensive inspections with a smaller d.c. unit used for intermittent inspections for broken wires. The Army concluded that its method for inspection is sufficient at this time. There is no need for the introduction of electric test equipment.

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ARMY WIRE ROPE INSPECTION

I. INTRODUCTION

1. Introduction. Wire rope is used in many Army applications and by regulation must be inspected periodically. Currently, wire rope inspection is done visually without the aid of equipment. With this method, the wire rope can be examined only on the exterior. For a complete inspection of the wire rope, the interior condition should be inspected. Nondestructive test (NDT) devices are available and in use in many countries. The Army has recently investigated the possibility of using these NDT devices, for inspections.

2. Background. There are three basic types of NDT devices: (1) a.c. devices which detect loss of metallic area, (2) d.c. devices which detect broken wires, and (3) used a.c./d.c. devices which do both. Belvoir Research and Development Center tested an individual d.c. device which performed satisfactorily in its ability to detect broken wires. MERADCOM Report 2371, "MT75 Wire Rope Tester," by Kathleen S. Chapman, November 1982, covers the testing and evaluation of this instrument. The Navy also has tested NDT devices. Their procedures, program, and conclusions are discussed in a letter report entitled "Navy Wire Rope Inspection Program," Appendix A. MERADCOM initiated a program to investigate the Army's need for NDT devices to inspect wire rope. An outline of this program included the following elements:

a. Become familiar with wire rope inspection requirements.

b. Identify major Army users of wire rope.

c. Determine quantities of various wire rope used by major Army users.

d. Prepare a User Survey for wire rope inspection.

e. Conduct the User Survey.

f. Determine the receptivity of Army major wire rope users to automated/electronic test apparatus.

g. Validate the Army's need for nonvisual wire rope inspection devices.

3. Scope. This report considers all of the elements outlined above. It presents the results of the Army User Survey and the results of the determination for a joint program with the Navy.

II. DISCUSSION

4. Investigation. The Army inspects their wire rope in accordance with the Department of the Army's Technical Bulletin TB 43-0142, which is equivalent to the Office of Safety and Health Administration (OSHA) requirements. This Technical Bulletin was acquired and reviewed.

5. Selection of Major Army Users of Wire Rope. An Inventory Management Specialist at the Defense Industrial Supply Center in Philadelphia, Pennsylvania, was contacted for information on major Army users of wire rope. A minimum utilization of 6,000 feet per two years was set as the criteria for an installation to be classified as a major Army user of wire rope. Within this criterion, four installations were cited as major Army users: Fort Benning, Georgia; Fort Carson, Colorado; Tooele Army Depot, Utah; and Fort Bragg, North Carolina. Table 1 shows amounts and typical diameters of wire rope ordered at each installation in a 2-year period. It should be noted that these installations use wire rope of greater and lesser diameters in addition to the sizes listed. For the purposes of this survey, only one size diameter wire rope of 6,000 feet or more was needed to determine a major Army user of wire rope.

Table 1. Amounts and Typical Diameters of Wire Rope Ordered

Ft. Benning	Ft. Carson	Tooele Army Depot	Ft. Bragg
9,000 ft of 5/8-in. diameter	315,000 ft of 3/8-in. diameter	6,000 ft of 5/8-in. diameter	18,000 ft of 3/8-in. diameter

6. Preparation of User Survey and User Performance. In order to assure uniformity of the information obtained, a Wire Rope Inspection Survey Questionnaire was developed (Appendix B). Each installation was surveyed by telephone. The personnel who supplied the information included a Deputy Maintenance Manager located at Fort Benning, a Field Maintenance Technician at Fort Carson, a Millrights Supervisor at Tooele Army Depot, and a Construction and General Inspection Foreman at Fort Bragg. All installations surveyed were cooperative and supplied most of the information needed.

7. Survey Findings.

a. Table 2 was prepared from the data gathered from the four installations. In general, the installations were found to be consistent in their answers to the survey.

Table 2. Wire Rope Inspection Survey Questionnaire

Question	Installation			
	Ft. Benning, GA	Ft. Carson, CO	Tooele Army Depot, UT	Ft. Bragg, NC
What equipment is wire rope used for?	Cranes, Wreckers	Cranes, Bridge Boats	Slings, Strongbacks, Cranes, Hoists	Cranes, Hoists
Is wire rope inspected visually or by other means?	Visually	Visually	Visually	Visually
Is any equipment used when inspecting wire rope?	No	No	Magnaflux is used occasionally	No
What document(s) do you adhere to when inspecting wire rope?	TB 43-0142	TB 43-0142, TM 5-725	TB 43-0142	TB 43-0142
How often is wire rope inspected?	Daily, and load tests	Monthly and quarterly depending on usage and load tests	Daily, and load tests	Daily, and load tests
Does inspection take place with wire rope on or off the equipment?	On equipment	On equipment	On and off equipment	On equipment
Who inspects the wire rope?	Operators	Operators	Industrial Cable Inspector and Repairer and Operators	All personnel
What forms are filled out for inspection?	DA Form 2404	DA Form 2404 DA Form 2407	DA Form 2409 DA Form 314	DA Form 2407
Are you aware of or have you used any electrical and/or mechanical inspection equipment for wire rope?	No	No	No	No

b. All four installations use a visual method to inspect their wire rope.

c. Wire rope is used on a variety of equipment such as cranes, hoists, strongbacks, bridge boats, and wreckers. Wire rope is also used for slings.

d. No electrical and/or mechanical instruments are used for inspection of wire ropes. Tooele Army Depot occasionally uses magnaflux.

e. All installations surveyed adhere to Technical Bulletin TB 43-0142, "Safety Inspection and Testing of Lifting Devices." This document specifies that wire rope is to be inspected visually daily. When wire rope is associated with an end item, it is to be inspected at the same interval as the end item. Special attention should be given to end attachments on the wire rope.

f. Daily inspection is performed by the operators of the end item. Tooele Army Depot uses an industrial Cable Inspector and Repairer to inspect wire rope used at their installation. Load testing is performed prior to initial use and on all new, extensively repaired, or altered lifting devices.

g. Inspection usually takes place with the wire rope on the end item. Tooele Army Depot occasionally inspects its wire rope off the end item.

h. There are no specific inspection/maintenance forms to be completed for the wire rope when it is a component of the end item. If it is an end item in itself, an inspection/maintenance form is completed.

i. All installations surveyed had never used electrical or mechanical inspection devices for wire ropes, nor were they aware of any such devices.

III. CONCLUSIONS

8. Conclusions. It is concluded that:

a. The nondestructive wire rope inspection devices that are available provide more information about the condition of the wire rope than do the visual inspection methods.

b. Although the installations contacted were not aware of nondestructive wire rope inspection devices, they were receptive to the use of these devices.

c. Information acquired from the Defense Industrial Supply Center revealed that the Navy uses three to four times more wire rope than does the Army. The Navy mainly uses greater amounts of the larger diameter wire rope.

d. It is more appropriate to replace small diameter, short length wire rope than it is to purchase nondestructive wire rope inspection devices for Army use.

e. The Army's method of inspection of wire rope is sufficient for meeting its needs at this time. Therefore, a joint program with the Navy is not planned.

APPENDIX A

LETTER REPORT

SURVEY OF NAVY WIRE ROPE INSPECTION PROGRAM

by

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Mechanical Equipment Engineering Division
Logistics Support Laboratory

May 1983

I. INTRODUCTION

1. Introduction. Wire rope inspection is a problem within the Navy as well as within the Army. Currently the Navy is using a method which does not lend itself to the inspection of the interior of wire rope. They use a technique which consists of holding a rag by hand, around the moving wire rope. If the rag is snagged, they search that area for a broken wire. A visual inspection is also performed at this time. Caliper measurements on the exterior diameters are taken to determine wear. Load testing is performed yearly. The Army currently uses a visual inspection method. The Army's and Navy's current procedures for detecting defects within wire rope are dangerous and sometimes inaccurate.

2. Background. An inspector for the Navy was fatally injured while inspecting wire rope on a large crane. This prompted the Navy to initiate a program to investigate the technology and capabilities of mechanical and electronic wire rope inspection devices. The Naval Facilities Engineering Command (NAFAC), found that three types of inspection equipment exist. Individual a.c. and d.c. units and unitized a.c./d.c. units. The alternating current units detect loss of metallic area (LMA). Direct current units detect broken wires or local faults (LF). Unitized a.c./d.c. units perform both jobs. The Naval Civil Engineering Laboratory (NCEL) in Port Hueneme, CA, was tasked to conduct tests on these non-destructive inspection devices. Usually either a.c. or d.c. equipment is used, seldom both. The NCEL acquired a d.c. unit from Magnetic Analysis Corporation, NY, a unitized a.c./d.c. unit called a Magnograph from Noranda Research Center, Quebec, Canada, and an individual a.c. unit was acquired (source unkown).

3. Purpose. The purpose of this report is to present the findings of the investigation into the Navy's Wire Rope Inspection Program.

II. DISCUSSION

4. Testing.

a. The d.c. unit, a.c. unit, and the unitized a.c./d.c. unit were tested side by side in laboratory and field tests. In laboratory tests, these units were tested on samples of wire rope with man-made defects such as broken wires, corrosion, etc. In field tests, they were used to inspect a Manitowac Crane, series 4100, having a lift capacity of 300 tons. The Magnograph unit was also tested on a floating crane, YD171, having a lift capacity of 350 tons. Naval Civil Engineering Laboratory, Technical Note N-1594, "Nondestructive Test Equipment for Wire Rope," by H. H. Haynes and L. D. Underbakke, October 1980, covers initial testing.

b. The Magnograph went through further testing to determine the operational limits of the equipment. Naval Civil Engineering Laboratory, Technical Note N-1639, "Test and Evaluation of the Magnograph TM Unit—A Nondestructive Wire Rope Tester, "by L. D. Underbakke and H. H. Haynes. July 1982, covers this additional testing. During testing the Naval Civil Engineering Laboratory concluded that a remote data recorder which could ride piggy-back on the sensor head was needed so that the inspectors would be able to obtain data from areas that are inaccessible or hazardous. Normally, the components of the Magnograph are all stationary. The remote data recorder makes it possible for the unit to be pulled along a wire rope, such as large tower guy wires. The remote data recorder was developed by Noranda Research Center. Naval Civil Engineering Laboratory, Technical Note N-1657, "The Remote Data Recorder: An Onboard Recorder for the Magnograph TM Nondestructive Test Wire Rope Sensor Head," by L. D. Underbakke, February 1983, covers the testing of this device.

c. The Navy inspectors needed a lightweight d.c. device for interim or preliminary inspections when broken wires were suspected. NCEL conducted a survey to find such a unit. Out of the products evaluated, the MT75 from NDT Technologies, Inc. South Windsor, Connecticut, was the smallest and easiest to use for local fault detection. The MT75 was tested in the laboratory on a wire rope with man-made faults. It was also tested in the field on a load line of a 35-ton truck crane. The testing of this device is covered by Naval Civil Engineering Laboratory Technical Report N-1661, "Test and Evaluation of the MT75 Rope Tester—A Handheld NDT Wire Rope Inspection Device," by L. D. Underbakke, March 1983.

5. Discussion of Findings.

a. A total of 5 pieces of equipment are needed when individual a.c. and d.c. inspection unit are used. The Magnograph used 3 pieces of equipment.

b. When a d.c. unit is used, the wire rope must be demagnetized before an a.c. unit can be used. This is a time consuming and hazardous procedure.

c. The d.c. unit operated at speeds of 50 to 500 ft/min. Extremely slow speeds are needed to locate broken wires for detailed visual inspection.

d. The Magnograph can pinpoint a local fault within 2 in. The d.c. unit locates local faults within 3 to 5 yd.

e. The Remote Data Recorder used with the Magnograph duplicates the performance of the Magnograph recording component. The data is recorded on a cassette which is removed and played back on the brush recorder component of the Magnograph.

f. The Remote Data Recorder has a remote time start-up circuit, which permits the inspector to leave a hazardous area before starting the recorder. It also has an auto start, which can be set from 1 min to 12 h 59 min.

g. The MT75 has a speed compensation circuit which amplifies the signal, allowing the wire rope to move as slow as 5 ft/min or as fast as 500 ft/min with no significant change in the signal.

h. The MT75 is a lightweight handheld unit. At rope speeds in excess of 200 ft/min it becomes difficult for the inspector to hold the unit. The inspector can be pulled along with the MT75 if it snags a fault on the wire rope, or it could be pulled out of the inspector's hands. The MT75 can be removed by pulling it perpendicular from the wire rope, which helps in eliminating this problem.

III. CONCLUSION

6. Conclusion. The Navy concluded that:

a. Both the exterior and interior of a wire rope must be inspected for local faults and loss of metallic area for a complete inspection.

b. Based on their testing results, the Magnograph was found to be superior in ease of use and performance to the individual a.c. and d.c. units. They recommend that the Navy procure [illegible]ized a.c./d.c. equipment for meeting its needs in inspecting metallic wire rope.

c. The remote data recorder for the Magnograph should be used in hazardous areas and areas which deny inspectors access.

d. The MT75 is recommended by the Navy to be used as an inspection instrument for small diameter (3/8 and 3/4 in.) wire ropes. It provides information that cannot be obtained from the rag and visual inspection methods. It can also greatly reduce inspection time.

e. The Naval Facilities Engineering Command funding for the wire rope inspection equipment program has been exhausted. The Office of Naval Research has been funded for further research in the wire rope inspection area. Their program will be followed by the Naval Facilities Engineering Command.

f. Ten MT75 units are scheduled to be procured for by shipyards and other installations for use in inspections of wire rope. Two to three Magnograph units have also been procured for use.

g. Further testing is needed using the Magnograph and MT75 so that a glossary of defect signals can be published to assist inspectors in data interpretation.

APPENDIX B

WIRE ROPE INSPECTION SURVEY

1. Location. _____

2. Organization. _____

3. Name. _____

4. Title. _____

5. Phone: AV _____ Commercial _____

6. What equipment is wire rope used for? _____

7. Is wire rope inspected visually or by other means? _____

8. Are any instruments or gages used for wire rope inspection? _____

_____

9. What document do you adhere to when inspecting wire rope? _____

_____

10. How often is wire rope inspected? _____

11. Does inspection take place with wire rope on or off the equipment ? _____

_____

12. Who inspects the wire rope? _____

13. What forms are filled out for inspection? _____

_____

14. Are you aware of or have you used any electrical or mechanical inspection equipment for wire rope? _____

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